receiver, the side information can be extracted from the encoded bitstream, and used to control the post-processor **116**.

[0019] Encoding Basics

[0020] In video coding systems, a conventional encoder may code a source video sequence into a coded representation that has a smaller bit rate than does the source video and, thereby achieve data compression. A conventional decoder may then invert the coding processes performed by the encoder to retrieve the source video. Coding engine **108** may be a conventional encoder, and decoder **112** may be a conventional decoder.

[0021] A video system may include terminals that communicate via a network. Each of the terminals may receive source video data locally and code the video data for transmission as encoded video to another terminal via a channel in the network. In duplex (two-way) communications systems, a terminal at each end will encode video sourced at that end. Each terminal may then receive the coded video data of the other terminal from the network, decode the coded data and display or store the recovered video data. Video terminals may include personal computers (both desktop and laptop computers), tablet computers, handheld computing devices, computer servers, television devices, media players, and/or dedicated video conferencing equipment.

[0022] The encoder system may output the coded video data to the channel, which may be a storage device, such as an optical, magnetic or electrical storage device, or a communication channel formed, for example, by a computer network or a communication network such as a wired or wireless network.

[0023] A decoder system that may retrieve the coded video data from the channel, invert the coding operations performed by the encoder system, and output decoded video data to an associated display device.

[0024] FIG. **1** is a block diagram of an example of a video communication system. With reference again to FIG. **1**, a simplex (one-way) terminal may be the transmitter **120**. The transmitter **120** may receive image data from a video source **102** that provides video data as a sequence of video images. The video source may be a camera that may include an image sensor to capture an optical image. Pre-processor **104** functions applied to source video may include converting the format conversion as well as image quality enhancements. For example, the captured image data may be captured in the RGB color domain. The captured image data may also be in the linear domain or be in a sensor/camera specific transfer function that may have to be converted to another domain (e.g. back to linear). The captured data, given the characteristics of the imaging sensor, might also require a de-mosaicing algorithm to be applied in order to convert them to a full resolution color image. Video may also have been processed by other steps that follow the capture process, and may include an automatic or manual (guided) color grading process, as well as other steps such as cropping, rescaling, and frame rate and bitdepth converted. The video source may alternatively be a storage device that stores video data authored from other sources (for example, computer graphics or the like). The video data will conventionally be converted to Y'CbCr prior to compression operations using a video codec, though other color spaces may be used by coding engine **108**.

[0025] A pre-processor **104** receives a sequence of source video data and performs pre-processing operations that condition the source video for subsequent coding. Video pre-processing may be performed upon source video data to render video coding more efficient by performing video processing operations on video pictures such as spatial and or temporal de-noising filtering, bilateral filtering, rescaling or other kinds of processing operations that may improve the efficiency of the coding operations performed by the encoder.

[0026] A coding engine **108** performs encoding operations on the converted input signal. The encoder may exploit temporal and spatial redundancies in the video data. The encoder may perform motion compensated predictive coding. The coding engine may operate according to a predetermined protocol, such as H.263, H.264/AVC, H.265/HEVC, VP8, VP9, or MPEG-2 among others. The coded video data output from the coding engine may therefore conform to a syntax specified by the protocol being used. FIG. **2** is a block diagram of an example video compression system, and is one example of coding engine **108**. The coding engine **108** may include an encoding pipeline further including a transform **206** unit, a quantizer **208** unit, an entropy coder **210**, a motion prediction **214** unit may include both intra-frame prediction and motion compensated prediction, and a subtractor **204**. The transform **206** unit may convert the processed data into an array of transform coefficients, for example, by a discrete cosine transform (DCT) process or wavelet process. The transform coefficients can then be sent to the quantizer **208** unit where they may be divided by a quantization parameter. Information from the motion prediction **214** unit as well as the quantized data may then be sent to the entropy coder **210** where they may be coded by run-value, run-length, or other entropy coding for compression.

[0027] A decode unit **220** decodes the coded video data from the encoder by performing the inverse operations as performed at the coding engine. It may also include an in-loop post-processing **216** unit that may include processes that try to compensate artifacts that may have been introduced by the characteristics of the predictive, transform coding, and quantization processes. In-loop post-processing could include techniques such as in-loop deblocking, sample adaptive offset (SAO) processing, the adaptive loop filtering (ALF) process, or other techniques such as de-banding, sharpening, dithering, and de-ringing among others. After in-loop post-processing, pictures are commonly sent to a reference picture cache **216** and/or a display. A reference picture cache **216** stores previously decoded pictures and other pictures that may be used by the motion prediction unit **216** as reference pictures for future encoding operations.

[0028] A channel coder (not depicted) may format coded video data for transmission in a channel, and may add error detection or correction to identify or compensate for errors induced during transmission through the channel. The channel itself may operate according to predetermined communication protocols. The transmitter may format the coded video data according to the protocols that are appropriate for the channel and may output the coded video data to the channel.

[0029] Color Space Conversion Optimization

[0030] Conventionally, video captured in the RGB space will be converted to the Y'CbCr space, or sometimes called YCbCr, YUV, or Y'UV, via a transform function. This may